ORIGINAL

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems	)	PR Docket No. 93-61
	)	RM-8013

To: The Commission

COMMENTS
OF
MOBILEVISION, L.P.

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SUMMARY

MobileVision supports the Commission's efforts to promote the efficient operation and continuing growth of LMS services and enthusiastically favors the adoption of permanent rules for those services. MobileVision is the licensee of wideband pulse-ranging LMS systems which utilize technology developed over the last decade by its general partner, METS, a pioneer in the development of spread spectrum location technologies. MobileVision is one of only two providers of location services who have constructed wideband pulse-ranging systems in the United States.

The services offered by MobileVision include stolen vehicle recovery, emergency road service, IVHS-related services, fleet and transit management systems, and services that support and assist public health, safety and law enforcement activities. Market studies, focus groups and market experience conclusively demonstrate that the public demand for such services, packaged to meet the individual needs of system users, coupled with ancillary communication services, is substantial. Indeed the level of demand for uniquely bundled LMS services assures that LMS providers offering innovative services at an affordable price can achieve sufficient market penetration for long-term viability.

Based on its expertise and accumulated experience, MobileVision supports the Commission's proposal to adopt allocation and licensing provisions in permanent rules that will

assure the separation of wideband and narrowband LMS systems. As to wideband system licensing, it strongly recommends adoption of the licensing alternative for such systems that will assure their protection from debilitating interference for an initial five year period, through co-channel separation, and thereafter.

Narrowband location services, by their nature, will interfere and must be accommodated on spectrum separate from that allotted for wideband systems as provided under the interim rules adopted in 1974. Similarly, wideband licensees, in order to develop systems that meet the public's demand for a broad range of sophisticated location services -- a goal that requires system design which maximizes capacity (to meet the level and variety of demand) and preserves optimum accuracy (especially in the case of

wideband LMS without degradation to accuracy and with the capacity needed to meet market demand.

MobileVision believes that sufficient competing technologies exist in the marketplace today to assure continuing pressures on LMS service providers to reduce costs and to continue to develop innovative new services and technical approaches in the industry. MobileVision supports the adoption of the proposed rules for location services which expand end user and licensee eligibility as well as permissible uses of LMS systems, which further provide an environment for narrowband and wideband operations free from unreasonable levels of debilitating interference and which establish technical parameters that promote flexibility in system design and operation.

The most critical element, MobileVision believes, in structuring permanent rules is the manner in which they come to terms with the matter of interference. Absent the protection against interference offered by the licensing scheme that MobileVision supports, the marketplace will be less competitive and the public will be denied important location services at any price.

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Commission's Rules to Adopt	)	
Regulations for Automatic	)	RM-8013
Vehicle Monitoring Systems	)	

To: The Commission

COMMENTS OF MOBILEVISION, L.P.

MobileVision, L.P. ("MobileVision"), by its attorneys and pursuant to Section 1.415 of the Commission's rules, 47 C.F.R. § 1.415, hereby submits its Comments in response to the Commission's Notice of Proposed Rulemaking ("Notice" or "NPRM") issued in the captioned proceeding.

MobileVision is the licensee of Automatic Vehicle Monitoring ("AVM") systems in various cities throughout the country. It supports the Commission's efforts to promote the efficient operation and continuing growth of AVM services and enthusiastically favors the adoption of permanent rules for those services.

I. INTRODUCTION

A. Summary of the Notice

The Commission initiated this proceeding to seek comments on proposed amendments to Part 90 of its rules

governing the licensing and operation of AVM systems in the 902-928 MHz band. Specifically, the Commission proposes to rename the service the Location and Monitoring Service ("LMS") and seeks comment on the following proposed spectrum allocation, licensing and operational parameters for the new service:

- Proposals that wideband pulse-ranging and narrowband LMS systems be licensed in separate portions of the 902-928 MHz band, with wideband systems operating on the frequencies 904-912 and 918-926 MHz and narrowband systems operating in the remainder of the band;
- Proposals to license both wide and narrowband systems on a non-exclusive basis in their respective portions of the band and an alternative proposal that would protect current licenses of wideband systems from interference for a five-year period and beyond;
- A proposal that would require all narrowband systems currently licensed between 904-912 and 918-916 MHz to migrate out of those bands and on to frequencies in the narrowband portion of the LMS band;
- A proposal to expand end user eligibility to include individuals and the federal government;
- A proposal to expand licensee eligibility to include private carriers;
- A proposal to expand permissible uses of LMS systems to include location and tracking of all objects, animate and inanimate, and the transmission and reception of status and instructional messages related to the units involved;
- A proposal to adopt measures that would help to preserve the reliability and quality of LMS service;
- A proposal to authorize each wideband pulse-ranging system to utilize 250 kHz of spectrum in the 8 MHz band for which it is not primarily licensed -- specifically 924.890-925.140 MHz for systems authorized in the 904-912 MHz band and 904.375-904.625 MHz for systems in the 918-926 MHz

band -- to establish so-called forward links for contacting the units to be located;

- A proposal to limit the period in which licensees are required to construct and place LMS systems into operation to eight (8) months from the date the license is granted;

- A proposal to permit all types of emissions to be used within the band without limitation; and

- Proposals to require that all LMS equipment be type accepted, and setting other technical limitations on frequency tolerance (for wideband systems, only), maximum power and out of band emissions.

The Notice also solicits comments and suggestions concerning alternative licensing schemes, specific technical and operational requirements of LMS systems, and the effect that the Commission's proposals are likely to have on the continued development and deployment of LMS systems throughout the country.

MobileVision will address each of these subjects in turn, bringing to bear its extensive experience and expertise in LMS research and development dating back to the earliest days of location-finding technology, as well as its experience in deploying that technology in the marketplace. In addition, MobileVision will recommend approaches that differ in some instances from those which the Commission has set forth, but which it believes the Commission should consider and adopt in order to preserve for the public good any possibility that LMS technology can be brought to the marketplace, compete there for the public's support and survive there on the basis of public acceptance by offering the broad range of services made possible by the technology developed to date.

B. Background

1. Developments Leading to the Interim Rules.

In the late 1960's and early 1970's the Urban Mass Transportation Administration ("UMTA") of the Department of Transportation recognized the crucial role that AVM would play in the future of transportation throughout America's cities.[1] In the early 1970's, UMTA awarded contracts to several corporations to demonstrate AVM systems.[2] Carefully monitored by UMTA and the MITRE Corporation, tests were run on each of these test systems over a significant area within Philadelphia, Pennsylvania. In addition and at their own expense, other major corporations, understanding the wide range of advantages associated with AVM, began testing systems in cities and suburban environments

fixed signposts,[3] would not permit accurate position determination. However, several important lessons were learned during this period which would lead to the future development of effective radiolocation-based AVM systems.

First, it was discovered that the high degree of multipath bias encountered in both dense and moderately dense urban environments probably rendered technologies other than wideband pulse-ranging impractical for vehicle location.[4] Tests conducted by the Hazeltine Corporation using pulse technology (lead edge tracking) in downtown Manhattan, demonstrated vehicle-to-single station dynamic multipath dispersion of a few hundred feet. Tests conducted in Philadelphia (using a standard 25 kHz UHF channel for phase tracking) demonstrated dispersions of about two thousand (2000) feet with virtually unrecognizable improvement attained using a few hundred kilohertz bandwidth, which was composed of several adjacent 25 kHz channels.

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3 Fixed signposts and their successor narrowband systems today, tag readers, do not "locate" vehicles. Rather, such systems identify vehicles when they reach known fixed "reader" locations.

4 Multipath bias or ducting is a distortion of the position determination which occurs when the wideband pulse-ranging signal is not in a line-of-sight position with respect to the receive site. Because the pulse signal is reflected numerous times before it reaches the receive site its time of arrival at the site is later. Therefore, the mobile unit or vehicle is perceived to be farther from the receive site than it is. This phenomenon is very well described in Urban/Suburban Out-of-Sight Propagation Modeling by V. Erceg, S. Ghassemzadeh, M. Taylor, D. Li, And D. L. Shilling, presented in the June 1992 IEEE Communications magazine.

Second, the need for multilateration location solutions became obvious. Multilateration is the use of more stations than would be required in an open field when a line-of-sight path existed to each station from the vehicle. The need for multilateration is necessary because of multipath bias.

Third, it was learned that background noise levels and interference within populated regions over the radio bands available prior to 1974 (for example, in excess of one microvolt within the UHF band) could render AVM impractical before the concept could become commercially viable.[5] Interference and static multipath data were documented by the Sierra Research Corporation based on hundreds of thousands of independent signals within the UHF band which were recorded during the UMTA Philadelphia tests.

During the proceedings conducted by the FCC prior to the release of the 1974 interim rules, two requirements were apparent if AVM was to become commercially viable. First, in order for investments in AVM technology to become viable and to develop AVM systems with sufficient accuracy so they would benefit the public and efficiently utilize spectrum, a wide band of spectrum would need to be set aside for AVM. No spectrum had previously been allocated free from interference for commercial development and use of wideband pulse-ranging technology. The previous tests and studies, however, indicated that this spectrum

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5 See, U.S. Department of Transportation, Urban Mass Transportation Administration Automatic Vehicle Monitoring System Final Report, Report No. TR-0932, Contract No. DOT-UT-10024, dated February 1973.

would have to be relatively free from harmful interference if pulse-ranging technology was to be used for location purposes.[6]

Second, large scale capital investment also would be a necessary condition for providing effective AVM service. In addition to the costs associated with designing, manufacturing, installing and maintaining a considerable vehicular equipment inventory, it was clear that a high density of fixed radio sites and a well-staffed sophisticated central station with all its attendant communications interfaces were required.

2. The Interim Rules. In its order adopting the interim rules,[7] the Commission noted that the primary function of automatic vehicle monitoring was to "automatically determine and make available at a central point the position of each member of a group of vehicles." *Id.* at 1665 n.1.[8] The Commission contemplated that this would be accomplished through: "(a) acquisition of vehicle location data; (b) communication of location data to a processing point; (c) computerized processing data; (d) display to user of processed information." *Id.* at 1667 ¶ 6.

The rules themselves include technical standards to ensure efficient use of spectrum and thus quality service. The

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6 At that time, wide scale use of a technology later to be known as spread spectrum was already becoming the United States military's primary method for pulse ranging.

7 Report and Order in *Inquiry As To Automotive Vehicle Locator Systems In The Land Mobile Radio Services*, 30 RR2d 1665 (1974) (*"Interim Rules Order"*).

8 The interim rules also provided for ancillary services. 30 RR2d at 1665, n.1., 1667.

interim rules provided for the licensing of wideband pulse-ranging systems within the 904-912 MHz and 918-926 MHz bands. Thus, Section 90.239(c) of the Commission's Rules states: "[l]icensees for pulse-ranging AVM systems, requiring 8 MHz bandwidth may be authorized in the 904-912 MHz or 918-926 MHz band. . . ." 47 C.F.R. § 90.239(c). The order adopting the interim rules explained that the Commission provided "for wideband AVM operation in the frequency bands of 904-912 MHz and 918-926 MHz." 30 RR.2d at 1670 ¶ 10 (emphasis added).

The Commission also did two things to avoid interference problems that were anticipated. First, it provided for co-channel separation between wideband AVM systems. As the Commission explained, the 904-912 MHz and 918-926 MHz frequency bands were designed to accommodate "two separate wideband AVM systems . . . in each market."[9] Second, it established special licensing rules for narrowband systems. The Commission permitted

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9 *Interim Rules Order*, 30 RR.2d at 1671 ¶ 10. While MobileVision recognizes that much of the spectrum governed by Part 90, including AVM frequencies, is technically licensed on a shared basis pursuant to Section 90.173, the two-per-market AVM licensing scheme described in the *Interim Rules Order* is consistent with established Commission policy that such systems, when constructed and operating, will be protected from debilitating interference. Moreover, at the time of the interim rules, the concepts of private carriage and exclusive licensing under Part 90 were in their nascency, and the Commission lacked a readily available licensing scheme in which to fit AVM at the time. It also did not realize at the time that the "interim" rules would remain intact and unchanged for 19 years. Nevertheless, a reading of its record make its intent clear: based on the factual record before it in 1974, the Commission envisioned only two wideband licensees per market.

narrowband systems to use only the 903-904 MHz, 926-927 MHz, 20-50 MHz, 150-170 MHz, and 450-512 MHz bands. 47 C.F.R. § 90.239(c)(2),(3). As the Commission explained:

> [T]he proposed 900 MHz reallocation should encompass also those AVM techniques, other than the wideband method . . . Thus, the frequencies 903-904 and 926-927 MHz, which had been included in the proposed reallocation for wideband AVM, are being made available for such other systems.

30 RR.2d at 1671 ¶ 12. The Commission understood the difference between wideband and narrowband systems in 1974 and it designed the interim rules accordingly.

3. Technological Advances and Increased Consumer Demand Since 1974. Since 1974, AVM developers have made substantial advances in location technology which have made the service both commercially viable and widely affordable. For example, in 1974 the Commission noted that wideband AVM systems could accommodate "upwards of 10,000 vehicles [at] high capacity." *Id.* at ¶ 9. In contrast, current systems can accommodate millions of vehicles. Similarly, 1974 technology was conceptually and technologically limited to locating vehicles large enough to carry the necessary tracking devices. *Id.* at 1666 ¶ 4. Subsequently, computer microprocessors have allowed for miniaturization of tracking equipment, and as a result current technology is capable of locating a wide-range of objects both animate and inanimate. Furthermore, 1974 technology was only capable of locating vehicles within a distance of 1000 feet. *Id.* at 1666 n.6. Today's advanced microprocessors allow location which is accurate within 100 feet. Finally, the declining cost

of system components such as the advanced microprocessors, allows AVM licensees to provide these improved services at much lower rates. Therefore, AVM systems have become both commercially viable and affordable to a wide range of consumers.[10]

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10 Both the commercial viability of AVM systems and their capacity have dramatically improved since 1974 as a result of advances in very large scale integration ("VLSI"). VLSI

Consumer interest in AVM services has kept pace with this technological growth. In today's market there is a substantial commercial and individual demand for flexible and reliable automatic vehicle monitoring service for use in a wide array of practical applications. Thus, AVM systems can satisfy an immediate need for stolen vehicle recovery, emergency roadside assistance, fleet tracking and management, intelligent vehicle highway system requirements, and public health, safety and law enforcement assistance. Under the proposed permanent rules, licensees will be able to offer the public these and many other services which will be crucial to the commercial viability of the technology. Moreover, flexible permanent rules will stimulate continued investment, encourage development of new technologies and applications, and ensure that the latest technology reaches the consumer in a timely manner.

C. Interest of MobileVision.

MobileVision is a licensee of LMS systems in locations throughout the United States. The general partner of MobileVision is METS, Inc. (originally, Mobile Electronic Tracking Systems). METS was organized in 1984 to design, develop and market computerized vehicle management systems and since that time has been a pioneer in the development of LMS systems. Over the past nine years, METS has developed patented technologies for vehicle location and computerized mapping systems, and has proprietary technologies for on-board vehicle computer systems,

mobile data terminals and fleet management applications software packages.

In the development of LMS systems, METS has been an innovator in highly efficient radiolocation technology. It is fortunate to possess the most experienced and versatile technology team in its field and counts among its professional resources expertise present in the early LMS efforts that were the focus of the 1974 Interim Rule proceedings. METS also has valuable alliance or subcontract arrangements with world-recognized experts in the relevant communications fields. METS and MobileVision have invested more than $40 million in using these resources in developing, licensing and deploying a wideband, pulse-ranging LMS system, in response to the user needs determined by its market research studies. This development effort, made possible by the expertise available and the capital and time invested, has resulted in the system now licensed to MobileVision, which it believes to be the most accurate and flexible LMS system in existence. The valuable and unique attributes of this system have been demonstrated conclusively in a test system in place in Southern Florida.

The MobileVision system as developed is capable of simultaneously serving several market segments and providing multiple services to each. Market studies, focus groups and market experience have shown that consumers and commercial operators identify specific services and groups of services that must be offered on a packaged basis at a cost effective price. Consumer access to combinations of services and the ability of

service providers to offer them in packages of the customer's choosing is essential to the viability of LMS systems and the long term feasibility of providers bringing those services to the market. Neither the public nor LMS operators can benefit otherwise.

- Stolen Vehicle Recovery ("SVR"). The MobileVision system will permit rapid recovery of stolen vehicles and quick apprehension of auto thieves. Motorists and individuals who avail themselves of the services can also summon police assistance immediately whenever they believe themselves to be in danger.

- Emergency Road Service ("ERS"). Motorists experiencing mechanical breakdown or difficulties or suffering medical emergencies can summon and receive roadside assistance or contact MobileVision's twenty-four hour a day monitoring service, located at the network control center, without leaving their vehicle. Assistance can then be dispatched to the vehicle's precise location even when the motorist cannot identify that location. Ancillary communications services

would permit the motorist to identify the nature of the breakdown or medical emergency.[11]

- IVHS. The MobileVision system provides services which the Executive Branch, Congress and the Intelligent Vehicle Highway Society of America ("IVHS America") regard as necessary to promote increased highway and vehicle safety. IVHS products will employ communications and location technologies, such as those described herein, including SVR, ERS, MAYDAY transmissions, and services for increasing the operational efficiency of commercial fleets through vehicle location, management capabilities. MobileVision also plans future services to include IVHS-specific services, such as Traveller and Tourist information and route scheduling and planning systems.

- Fleet and transit management. Potential commercial users of MobileVision services include national and regional trucking companies; package, commercial and consumer delivery services; taxicab and other livery services; and repair and other

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11 Market studies indicate that the typical consumer would subscribe for bundled services that would include ERS and SVR and further suggest that the market penetration level for such combined services could approximate 20% of the households in each market area.

service fleet operators. Major government entities that are potential users include mass transit, public safety and emergency service providers.

Depending on each user's requirements, the available fleet and transit management services that can be provided include automatic vehicle location, computerized mapping, routing and scheduling, and emergency roadside service and ancillary communications services. The system would also have the capability to provide portable LMS services related to the activities of field service technicians, sales personnel, insurance-claim adjusters and other on-the-move workers whose whereabouts and movements are monitored and managed by the LMS system.

- Public health, safety and law enforcement assistance. The system would permit users to monitor the location of individuals when required. The system can provide affordable and miniaturized location systems to assist parents or public institutions in tracking and monitoring the whereabouts of children, hospital patients or other individuals and permit communications with them in the event of emergency or medical need. Similarly, penal institutions and correctional

officers can utilize such systems in connection with prisoner work-release and other probationary programs.

The MobileVision system has the capacity to provide such innovative services to millions of subscribers in each market service area.

Much of the preparatory work necessary to erect MobileVision's system in Chicago has been completed and the rest is underway; the hardware to do so exists in MobileVision's inventory and is currently being shipped to Chicago for installation. The deployment of MobileVision's system in Washington, D.C. has commenced. Similarly, rapid deployment of systems in other key metropolitan areas throughout the United States is to begin shortly.

MobileVision, as a partnership, is dedicated to the early, rapid deployment of its LMS system. Clearly, it has a real and substantial interest in utilizing its assets pursuant to its licensed authority. The capital demands of such an enterprise are obviously massive and in order to successfully attract the necessary capital to bring the technology to the marketplace, MobileVision has been vigilant in attempting to protect its licensed resources from being jeopardized by interference from other systems seeking authorizations in the same spectrum.[12] MobileVision is an interested party to this

[12] The design of the MobileVision system and its current deployment have been predicated on the provisions of the

Continued on following page

proceeding because the actions taken by the Commission herein will shape the boundaries and ground rules for the use of a portion of the electromagnetic spectrum and thereby, in a very real sense, will define the LMS marketplace.

D. Overview of Wideband Pulse-Ranging Spread Spectrum Technology[13]

1. General Description. The types of technologies available to the marketplace in the spectrum that is the subject of the NPRM are wideband pulse-ranging systems and narrowband tag reader systems.[14] Each type of system employs a different technology and consequently requires a different amount of spectrum. While wideband wide-area systems perform many functions performed by narrowband local-area systems, wideband pulse-ranging technology offers a vast array of additional services as well. For example, a tag reader system cannot

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interim rules and established Commission policy, reiterated to MobileVision representatives by the staff of the Private Radio Bureau, that such systems, when constructed and operating, will be protected from debilitating interference. The Rules adopted by this proceeding should take into account that these design efforts and capital expenditures were made in reliance on the existing rules.

13 Attached to these Comments is a Technical Appendix (Tab A) consisting of supplemental information to which, where noted in the Comments, the reader is referred for detailed technical explanation.

14 The Commission assumed in the early 1970s that these types of technology (along with "dead reckoning") would be the primary categories of LMS technology. *Inquiry as to Automotive Vehicle Locator Systems in the Land Mobile Radio Services,* Further Notice of Inquiry, 35 F.C.C.2d 692, 693 ¶ 4 (1972); *Interim Rules Order* at 1666-69 ¶¶ 4-7 (1974).

provide emergency road service, emergency medical service, stolen vehicle recovery, or full location services and management of fleet truck or delivery vehicles, since by its nature such a system requires the vehicle to come to the "locator" along a fixed route.

The system under license to MobileVision is a wideband pulse-ranging system that employs direct sequence spread spectrum technology.[15] Multiple towers receive pulse emissions from transmitters located on subscriber vehicles, or other mobile objects where appropriate, scattered throughout a wide service area and relay important information back to the system control center. A system control center then interprets the data being [illegible]

(e.g., motorist in danger, mechanical failure, or location of delivery trucks).

The signalling sequence generated by an LMS system can best be understood by reference to Figure 1 which shows a schematic of an LMS system and several of its essential components, including the receive fixed sites ("RFS"), the transmit/receive fixed sites ("TFS") and the network control center ("NCC"). The control center processes the data it receives via landline connections or radio frequency links from TFSs and performs the position determination calculation. For example, when a mobile unit transmits a signal indicating that the vehicle has been stolen or is in distress, that signal is received by the TFS. The TFS notifies the control center and instructs the mobile unit how to transmit its wideband pulse-ranging signal. This communication from the TFS back to the mobile unit uses the narrowband forward link and is absolutely critical to the location process because without it the wideband pulse-ranging signal used for determining the mobile unit's location will not be appropriately transmitted. In addition, the forward link must be available to the system operator on an uninterrupted basis so that capacity control techniques, such as TDMA and FDMA, may be used to maximize capacity. Upon receipt of its instructions from the TFS, the mobile unit then transmits its wideband signal, which is received by the RFSs and TFSs, and the RFSs and TFSs relay the time of arrival data via the TFSs to the control center for processing.